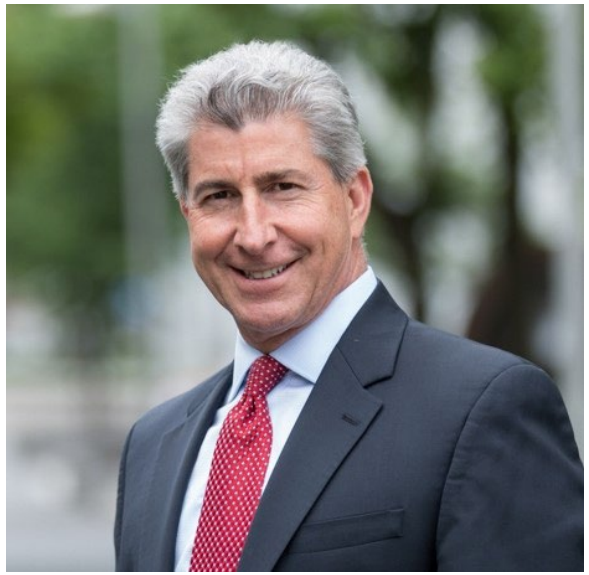
All About Project Hamilton

Central Bank Digital Currency (CBDC) Research

Talk About Payments Webinar
Retail Payments Risk Forum
June 9, 2022

Federal Reserve Bank *of* Atlanta

Today's Presenters



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Executive Vice President &
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Federal Reserve Bank of
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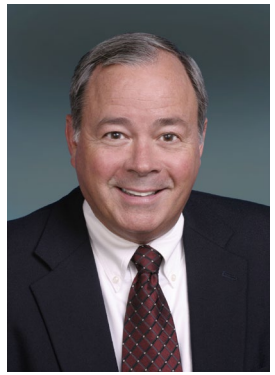

Dave Lott
Payments Risk Expert
Federal Reserve Bank
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Central Bank Digital Currency (CBDC) - Agenda

- General Purpose (or retail) Central Bank Digital Currency, what is it, what it's not, and why is it such a hot topic?
- What's happening around the globe?
- What's the Fed doing?
- What are the key policy/design questions?
- What's happening with wholesale CBDC?

Financial Institution Funds

- Funds are held by regulated private companies
- Transfer of the funds through a private or central bank-owned market infrastructure
- Conforms to a detailed set of rules to ensure market and financial stability
- Payments are unsecured debt until finality (<two secs – unlimited years)

Crypto

- Privately issued digital assets with their own 'currency' of account
- Deemed a form of speculative asset by central banks
- Built on Distributed Ledger Technologies and either publicly or privately owned

Stable Coins

- Digitally issued tokens, with the value tied to one or more underlying assets, such as a sovereign currency or company collateral
- Global Stable Coins (GSC) can be used for cross- border transactions, but recourse in the event of an exception may be limited by the local regulatory environment

CBDCs

- Central bank-issued digital cash, denominated in the local currency
- Liability remains with the central bank, the equivalent of cash
- Wholesale CBDC for financial institutions for interbank settlement
- Retail CBDC are generally available, a form of digital cash with the same ubiquity as cash

The foundation of a monetary system is the trust in the currency

CBDC Research - Why Now?

- Because of recent developments, many central banks have increased focus on general purpose CBDC, including the Fed
  - China announced that they have a production retail CBDC in pilot
  - In 2019, Face Book announces the formation of Libra, a retail private digital currency. Name changed to Diem and was **abandoned** in January 2022 and the assets sold to a bank
  - In October 2020, JPMorgan launched JPMCoin, a worldwide digital currency for internal JPMorgan customer use
  - Stablecoins growing in number and popularity
  - Bitcoin and many other private cryptos soar, again, but still not used widely for payments
  - In March 2020, two (unsuccessful) bills introduced as part of the Care Act would have directed the Fed to offer a CBDC with direct accounts at the Fed for CARES Act payments to citizens. New potential congressional actions also under consideration

Retail CBDC – What's Happening Around The Globe?

- China – In production pilot in many cities, focusing on integration with existing payment systems like AliPay and WeChatPay
- Bahamas – "Sand dollar" in production as of 10/2020
- Eastern Caribbean Bank – Launched Dcash March 2021(**down for over a week**)
- Sweden – Hired Accenture to build a platform. Executed small pilot in test environment, will continue pilot testing. No decision on production roll-out
- Canada – Announced it will build and test a prototype and partnered with MIT
- ECB – Q2 2021 announced two-year research effort focused on design and policy questions and technical experimentation. Testing could come as soon as 2023
- Japan – 12/21 announced they will be speeding up their research and second phase of research began in April 2022
- Russia - announced they will complete a prototype and begin pilot in 2022 with the second phase of trials beginning in fall of 2022

Retail CBDC – What's Happening Around The Globe?

- England – Formed two industry advisory group and recently issued a public consultation paper and recently partnered with MIT
- South Korea – Completed first pilot mock testing in January 2022
- Uruguay – Ran a production pilot in 2018 but ceased operations after the six-month effort.
- Ukraine – Limited pilot testing of "synthetic CBDC" in 2018 based on the Stellar Protocol. They are committed to continuing research through 2025 and have partnered with Stellar and Bitt
- Thailand – Building a prototype with public testing expected in late 2022
- Brazil – Working with Ripple to build a prototype and looking to have a pilot by end of 2022 and an introduction to a final version in 2024.

Project Hamilton: Track A Overview

- Multi-year joint technology research with MIT Digital Currency Initiative
- Creation of a functional research model retail CBDC platform
- Could support multiple use cases, but design/policy goals will influence options (p-to-p, POS, e-commerce, person to/from government and businesses)
- Various design choices and platform options will be coded and tested
- Project is technology agnostic. While we will look at DLT/blockchain, our requirements and research results will dictate the platform choices
- MIT/FRB Boston jointly published research findings and created an open source license for the software **in February 3rd, 2022**.
- **No decision on moving to pilot or production**

Project Hamilton: Track A Overview

- Phase 1 - Build a **core engine** to meet the key requirements of a nationwide US retail CBDC. Designs will be benchmarked to assess:
  - Scalability (goal of 100,000 transactions per/sec)
  - Speed (clearing & settlement in under 5 seconds)
  - Resiliency (highly resilient and & robust recoverability)
  - Security (privacy)

- Phase 2 - Code and test various **design/policy choices** to determine the impact on initial benchmarks and potential tradeoffs (e.g., privacy versus AML/CTF compliance)
  - Selected topics under exploration
    - Privacy vs AML/CFT compliance
    - Programmability (i.e. smart contract functionality)
    - Interoperability/cross border
    - Accessibility and offline

Project Hamilton: Phase 1 Results

- What we built are research grade platforms, not fully functional systems nor production ready code
- We approached the work with the following principles in mind
  - Technology agnostic
  - Built it ourselves in C++ to maximize learning
  - Flexibility to handle various policy outcomes and future changes
  - Minimize data stored in the core processing engine
  - Parallelize as much as possible
  - Platform would be controlled by the Federal Reserve, thus would not need the type of consensus used in open blockchain networks (e.g., PoW)

Project Hamilton: Phase 1 Results

- Phase 1 - Built two core engines, one maintains a global order of transactions (Atomizer) the other does not (Two Phase Commit (2PC))
  - Atomizer – achieved ~170,000 t/sec with 99% finality in under 2 seconds
  - 2PC – achieved ~1.7 million t/sec with 99% finality in under 1 second
  - Both are highly resilient with multi-tiered replicated architectures that are distributed across multiple physical sites in the cloud
  - Both rely on public/private keys to identify users
  - Both rely on unspent tokens (UTXO) model versus accounts
  - To move funds unspent tokens (inputs) are destroyed and new tokens (outputs) are created
  - Both are flexible to be able to handle any design/policy choices

Project Hamilton: Track B Overview

- Separate FRB Boston research effort
- Perform a comparative analysis of potential public blockchain and private CBDC platforms
- Test a small number of platforms to determine their ability to meet key benchmark requirements
- Purpose is to expand our understanding of the full range of potential platforms choices for CBDC
- No external publication of results is planned at this point

Retail CBDC Potential Use Cases

- Person to person (including offline capability)
- Consumer to business (POS and eCommerce, including to government)
- Business to consumer (payroll, benefits, refunds, change, including from government)
- Cross border (theoretical and many policy implications, but where we are in life cycle allows us to develop from ground up)
- Business to business – possible, but lack of rich data (e.g., remittance data) makes this challenging and not highly likely

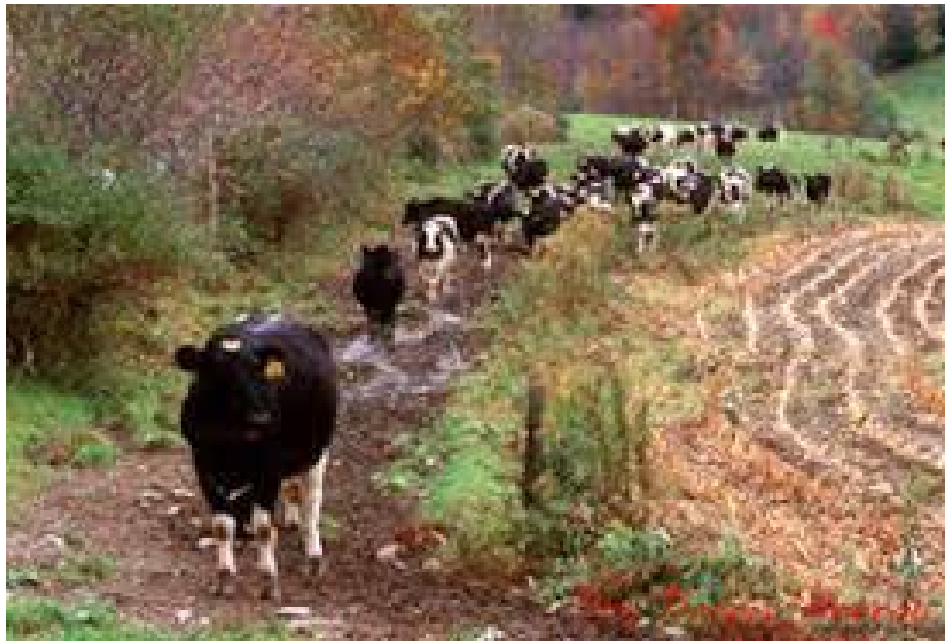
- Potential future – micro payments, IoT

- Financial inclusion as a possible public policy goal

Major CBDC Design/Policy Questions

While we are not establishing policy, policy considerations influence technical design, and technical capabilities/limitations can influence policy tradeoffs

DON'T PAVE THE COWPATHS, OR YOU'LL GET BOSTON STREETS!



Major CBDC Design/Policy Questions

On January 20th, the Board of Governors issued a public consultation paper to seek input on many of the issues noted below

- Privacy and traceability
  - How is identity verification performed?
  - How is ongoing AML/CFT transaction monitoring performed and by whom?
  - What identity and transaction data is visible to whom?
- Financial structure
  - Issued directly to the public from the central bank or through intermediaries (such as depository institution, non-bank financial institutions, FinTechs, others) or a hybrid?
  - Can end users store their own credentials without a custodian or payment provider?
  - Potential impact on bank deposits – Implications for bank funding and credit extension? Can certain technical features or distribution methods impact this?
  - Interconnectivity with traditional payment systems?

Major CBDC Design/Policy Questions

- **Cross-border**
  - Any technical restrictions to cross-border functionality?
  - Potential policy implications of increased cross-border transfers? Can certain technical features mitigate risks or increase benefits?
- **Security**
  - How are double spending and counterfeiting prevented?
  - Are lost or stolen funds recoverable?
- **Monetary policy implications**
  - Potential of CBDC as a monetary policy tool, such as via an embedded interest rate?
- **Financial inclusion**
  - Potential benefits to un(der)banked individuals?
  - What design/features increase or limit potential benefits?
  - Physical currency is free to banks and individuals, should CBDC be as well?

Major CBDC Design/Policy Questions

- **Innovation**
  - Can a CBDC facilitate greater innovation from the private sector or, conversely, squeeze out private sector innovation?
  - Should a CBDC include smart contract functionality (i.e. “programmability”)? What features should be supported?
- **Platform operations**
  - Operated by the central bank?
  - Can certain platform roles be shared with the private sector?
- **Wallet design**
  - How are offline transactions performed and eventually reconciled?
  - Wallet or transaction limits?
  - How are wallets built and provisioned?

Wholesale CBDC – What's Happening Around the Globe?

- Singapore – Project Ubin. Testing since 2016, including multi-platform, multi-currency cross border (DVP, PVP) with Canada and UK
- Canada – Project Jasper. Testing since 2016
- US – FRB Boston tested from 2016-2018
- Japan/ECB – Project Steller. Testing since 2017
- UK – Amongst early testers, but now focused on consultation only
- BIS Hong Kong Innovation Hub – Starting cross border work with Hong Kong, China, UAE and Thailand
- FRB NY BIS Innovation Center – recently launched Project Cedar, a narrowly focused wholesale CBDC focusing on currency swaps
- Also - Brazil, Australia, France, Saudi Arabia, South Africa

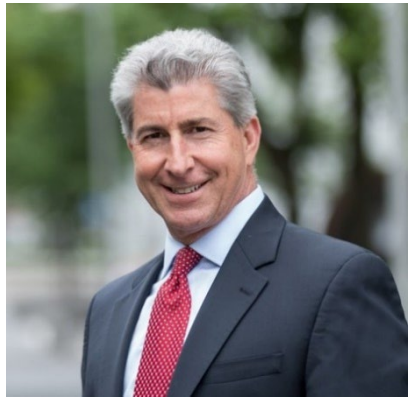
What Questions Do You Have?

Please submit through the Q&A panel

Project Hamilton: Phase 1 Document (Feb 2022)

Board of Governors: Retail CBDC and Monetary Policy (May 2022)

Presenter Bios



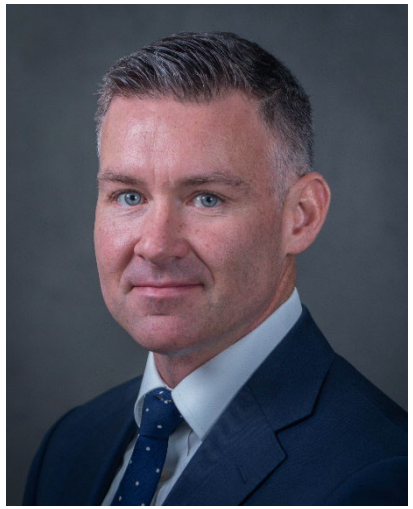
Jim Cunha is the Executive Vice President and Interim COO at the Federal Reserve Bank of Boston. His entire career has focused on the interrelationship of payments, security, technology and innovation.

Cunha is the interim COO as the Fed looks to replace its recent President who retired early due to health reasons.

Cunha leads the Federal Reserve's Secure Payment efforts, which seeks to reduce fraud in the U.S. payments system through collaboration with industry participants.

Cunha is also spearheading the Boston Fed's efforts to study distributed ledger technology, or blockchain, to determine potential benefits and risks in financial services for internal and external uses. He is also responsible for the Bank's technology research related to central bank digital currencies (CBDC), including a joint research effort with MIT's Digital Currency Initiative.

Cunha has worked at the Boston Fed since 1984. Prior to that, he worked at Fleet National Bank. He holds a bachelor's in accounting and philosophy from Northeastern University and a bachelor's in computer science from Rhode Island College.



Robert Bench is an Assistant Vice President of Applied Fintech Research at the Federal Reserve Bank of Boston. Bob's research focuses on general purpose central bank digital currency software design, development, and infrastructure.

FRB-Atlanta Resources

- *Retail Payments Risk Forum*
- Blogging every Monday at *Take on Payments*
- *Consumer Surveys*
- *Federal Reserve Payments Study*
- *Payments Inclusion*
- *Community Bank Access to Innovation through Partnerships*
- *Conducting Due Diligence on Financial Technology Companies: A Guide for Community Banks*

Email comments/questions to:

Dave Lott